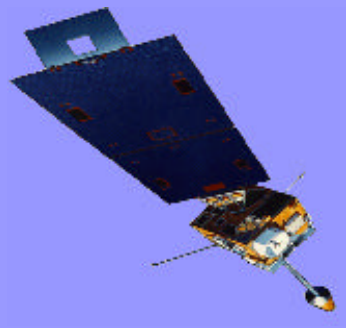


GOES I-M On-Orbit Storage

SpaceOps 98

Tokyo, Japan

John Fiorello/CSC

Doug McCuistion/NASA (presenter)

GOES: Chronology of Coverage

NASA/NOAA GEOSYNCH CHRONOLOGY

ATS-1, 2, 3

SMS

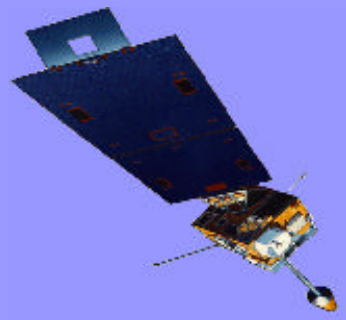
GOES Spinners

- **GOES D-H**

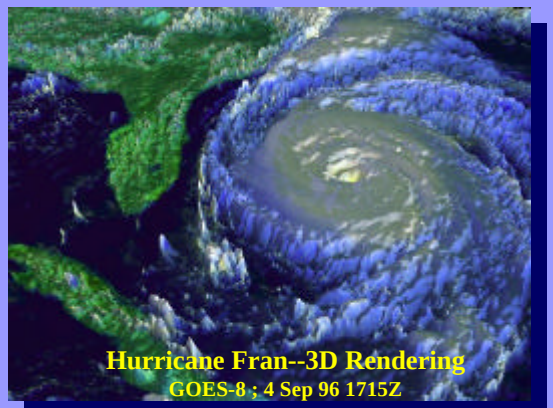
GOES 3-Axis

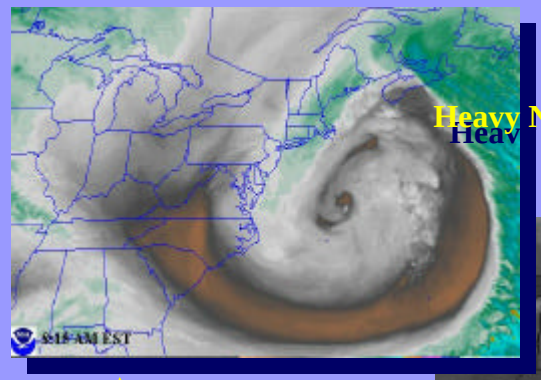
- **GOES I-M**
- **GOES N-Q**

Advanced Studies



GOES Products for Forecasting

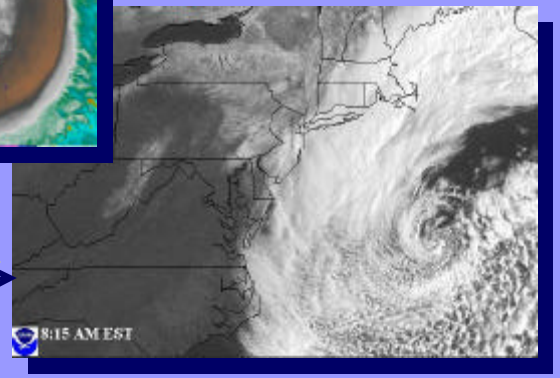


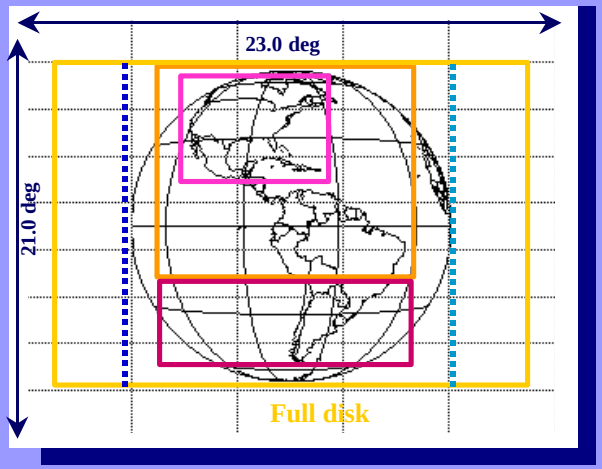


Heavy Northeastern U.S. Snowstorm
GOES-8 : 1 Apr 98 1215Z

Wator Vapor

Visible

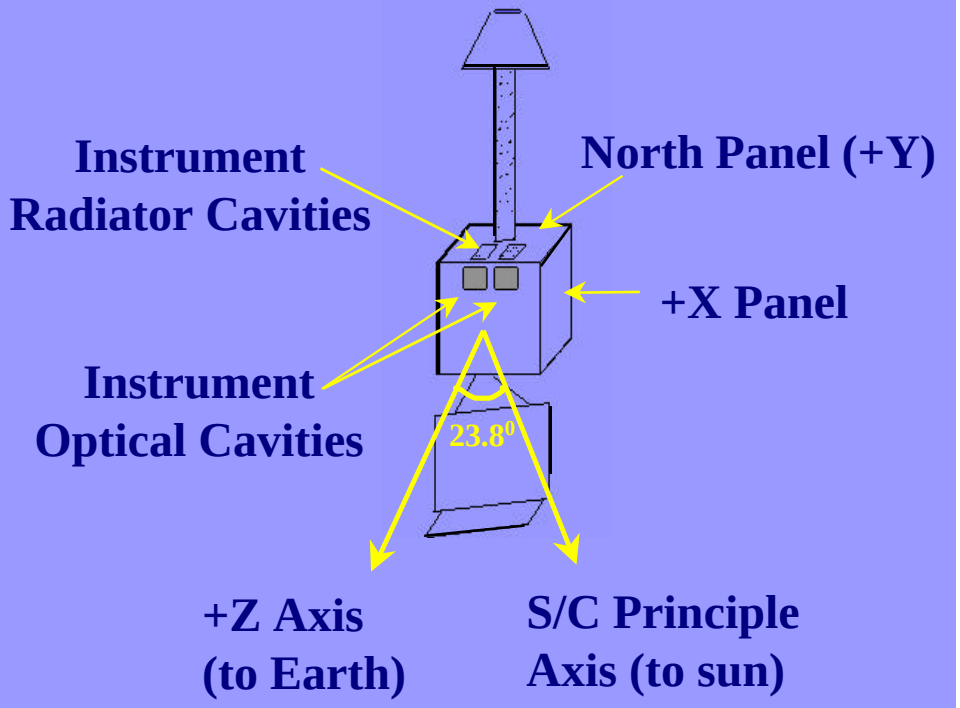




Instrument Fields-of-View

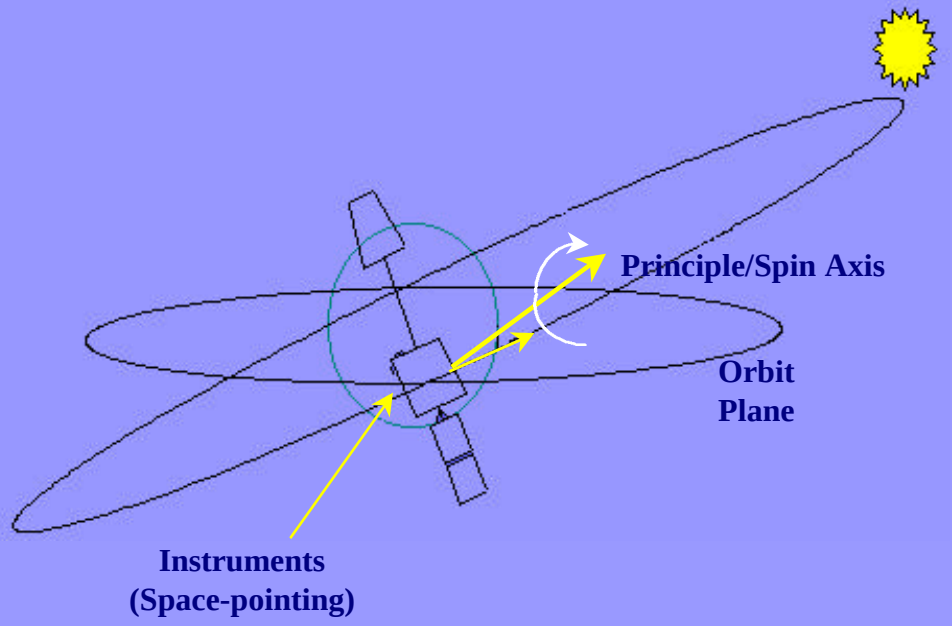
-Z Axis Precession (ZAP) Storage Spin-up & Dynamics

- Spacecraft powered down to eclipse configuration:
  - » Gyros (initial spin-up only)
  - » Attiude Control Electronics and Telemetry & Command equipment on
  - » Magnetic Torquers for additional spin control
  - » Heaters
- Solar Array slewed to 151^0
  - » Two slews
  - » Sun Acquisition Mode commanded between slews
- Orient spacecraft principle axis to sun
- Coordinated thruster firings to initiate spin



ZAP Mode Performance (1/2)

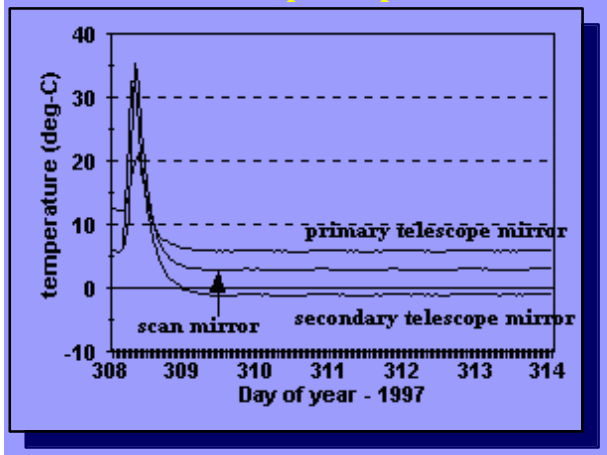
- 0.75^0/sec roll about major principle axis of inertia (23.8^0 off Z)



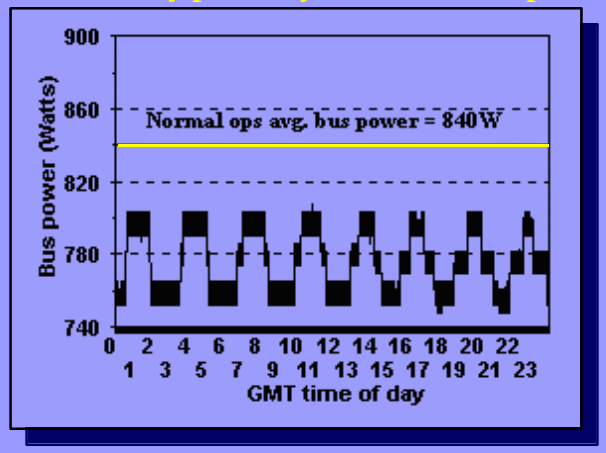
- Return to normal on-orbit mode extremely simple
  - » Sequence of sun acq/roll earth acq/station keeping utilized routinely
  - » Payload accomodations necessary before returning to operations

ZAP Mode Performance (2/2)

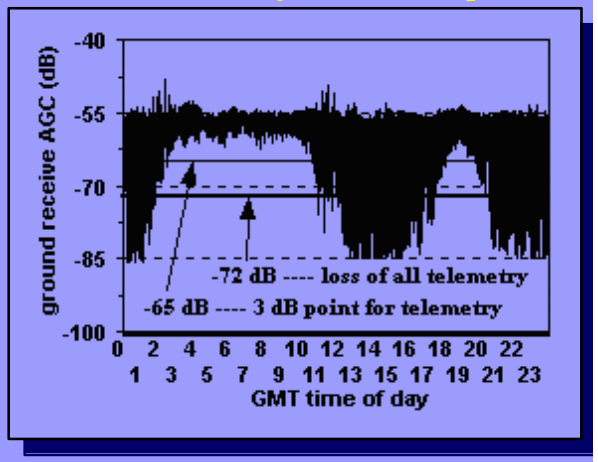
Instrument Telescope's rapid cool-down



Solar Array power cycles with ZAP spin

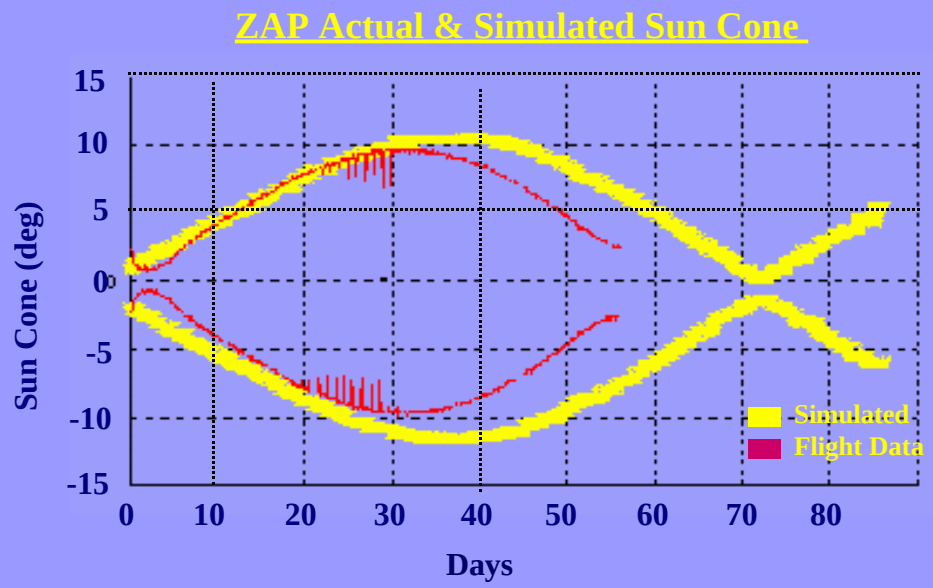


Ground AGC is cyclic in ZAP spin



Spin Precession Requires Re-spins

- Principle Axis/Body Frame Axis angular seperation causes precession from initial coning angle relative to sun
- GOES-10 precessed at 0.4^0/day on initial activation
  - » At this rate, respin required every ~50 days
  - » Reductions possible with better Solar Array positioning relative to the sun
- Respin execution identical to initial spin but without Solar Array repositioning.
  - » First execution of respin successful
  - » Precession rate reduced to 0.35^0/day (~ 60 day respin)



ZAP Ground Operations (1/2)

- **Pseudo-telemetry "automates" monitoring**
  - T&C System (GIMTACS) algorithms developed and implemented for autonomous telemetry monitoring:
    - » Predict spin rate
    - » Predict T&C nulls, compare to actual ground system nulls; alarm if anomalous
    - » Predict sun coning angles from course sun sensor output and alarm if $>20^0$
    - » Predict eclipse entry & exit (automation of eclipse configurations)
    - » Detect anomalous solar array power and alarm if anomalous
    - » Detect loss of command link, and alarm
    - » Calculate spacecraft true local time
  - 13 new pseudo-telemetry points added for these functions

- **Staffing reduced from 3 full- to 1 part-time operators (per S/C)**
  - Operational GOES Engineer monitors Storage S/C console
  - Full team required only for respins

ZAP Ground Operations (2/2)

- Pseudo-TLM points reduce real-time monitoring
- All TLM archived for analysis/trending
- **No immediate action contingencies eliminate quick reaction responses**
- **Minimal ground resources required, leaving redundancy intact**
  - One ground antenna (only for command link testing)
  - One GIMTACS stream

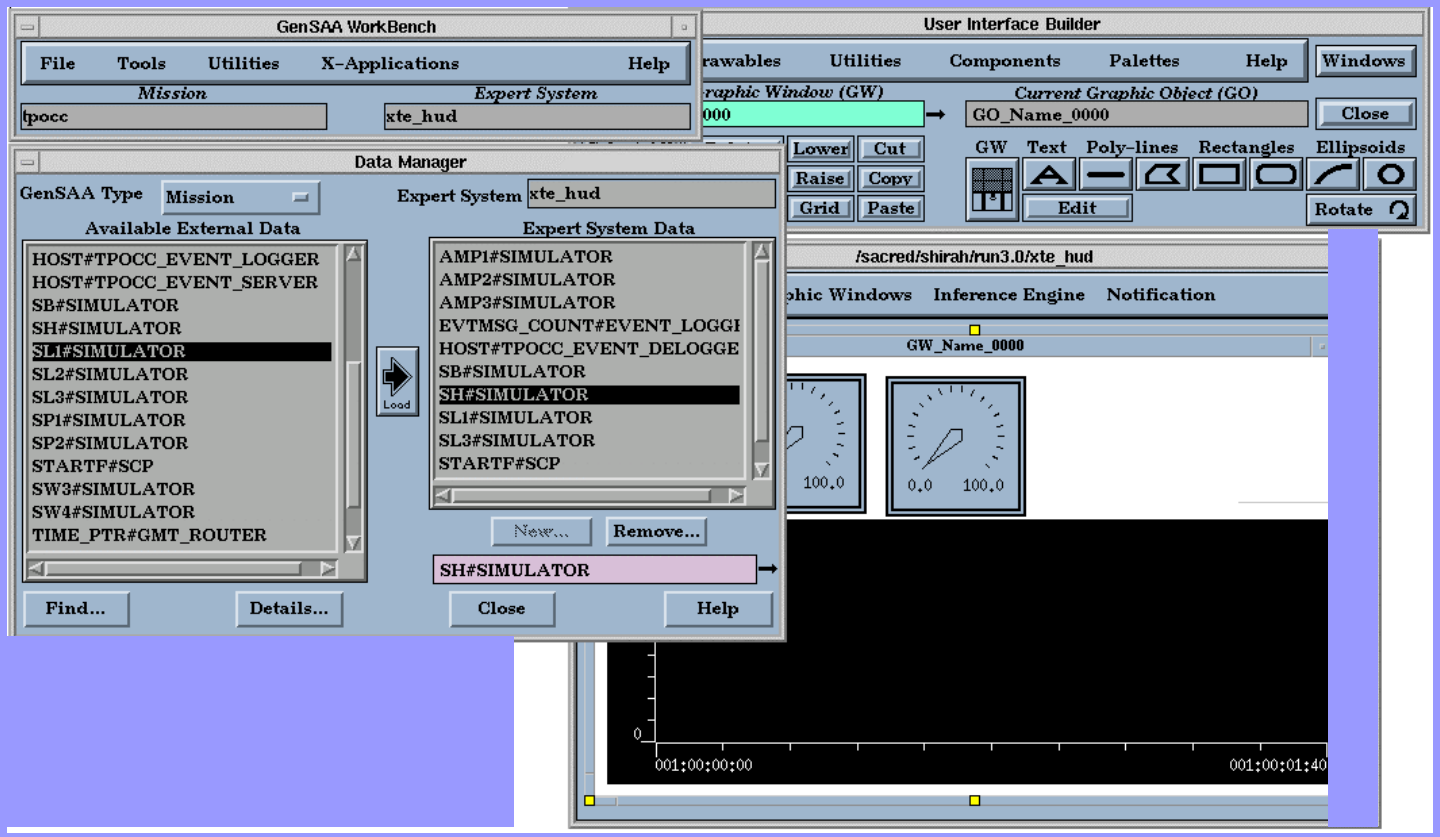
The Future of GOES On-Orbit Storage (1/3)

ZAP STORAGE PROVIDES FLEXIBILITY

- On-orbit asset state-of-health and launch ques may result in a fourth GOES on orbit next year
- GOES-L (to be GOES-11) can be stored with minimal impact to ground resources
- Required operating mode of GOES N-Q (next generation)
- Incorporation of an Expert System for satellite state-of-health modelling will assist on-line operators in monitoring multiple stored spacecraft, with added safety

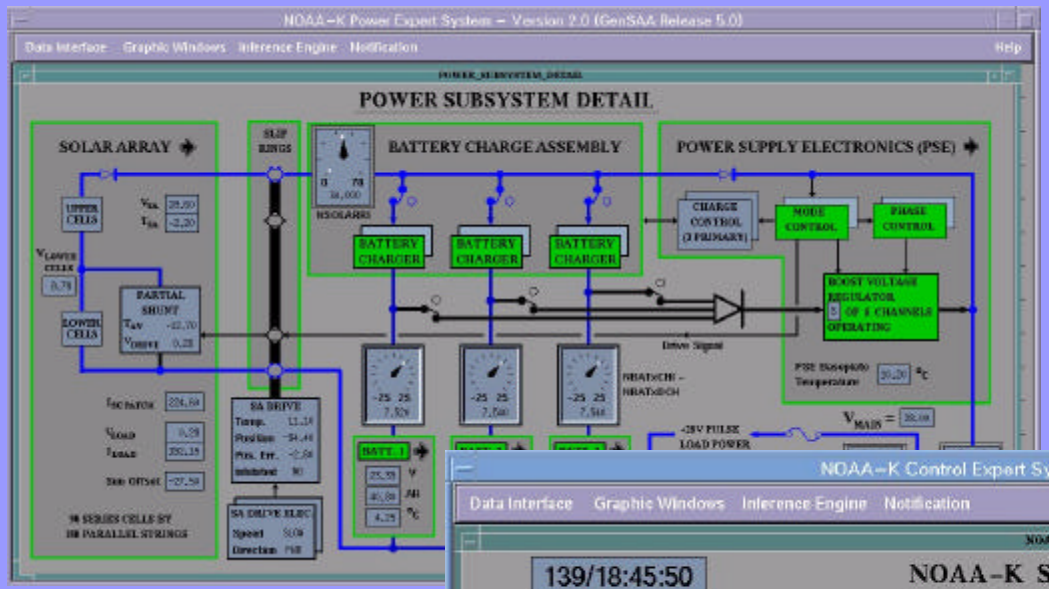
The Future of GOES On-Orbit Storage (2/3)

Generic Spacecraft Analyst's Assistant (GenSAA) for near-term automation of on-orbit storage



GenSAA Data Manager & User Interface

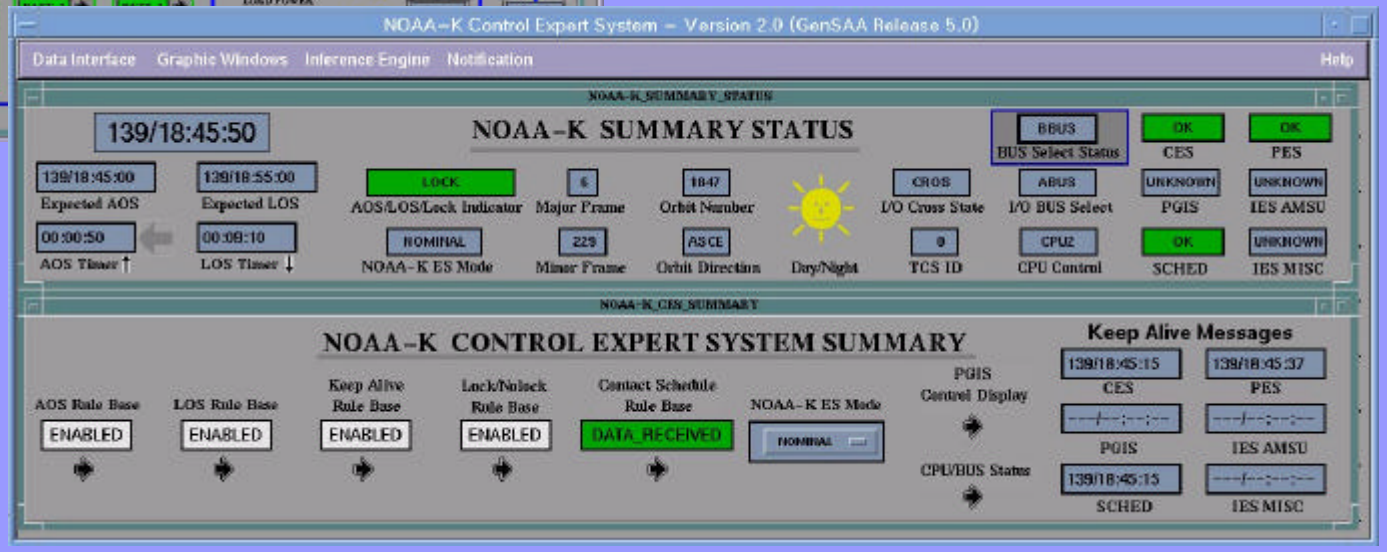
The Future of GOES On-Orbit Storage (3/3)



GenSAA's NOAA-K APPLICATION

Sample Subsystem Monitor Page

Sample Subsystem Monitor Page



Sample Spacecraft Status Page

Sample Spacecraft Status Page